THE UTILITY and ADVANTAGES OF Broad High Wheel-Carriages, DEMONSTRATED RATIONALLY and MATHEMATICALLY,

SO AS TO BE

Underſtoood by any common CAPACITY.

HUMBLY INSCRIB'D

To the COMMISSIONERS and TRUSTEES of
the ſeveral TURNPIKES and SURVEYORS of
the HIGH-WAYS in GREAT-BRITAIN.

By MOSES WICKHAM,
Of *Hatfield*, in the County of *Hertford*.

Utere ſapientiâ, & Prejudicium fugito.

LONDON:
Printed for J. SCOTT, at the *Black Swan*, in
Pater-noſter-Row.
(Price One Shilling.)

1496

BRITISH MUSEUM

THE
PREFACE.

IT were as ridiculous in me to commence an Author, as it would be to light a Candle to the Sun on the 22d of June, *when he is in his Meridian Splendor, were it not that I have ſomething to offer to the World that has been omitted by all the great Genii now in Being, who are equal to ſuch a Taſk; whether it be like the Eagle, they will not ſtrike at inferior Game, ſuch as Wrens, Sparrows, or Tom-tits; or whatever it be, it is plain, that they have thought proper to omit it. Under this Conſideration I have preſumed to plume my Feathers, and try if I can take one little Flight among them; hoping, at the ſame Time, that tho' I ſhould not fly ſo* *ſo high, ſwift, or well as they, they will not combine together like Pies upon an Owl, and ferret me out of their Element; but conſider that moſt young Birds do fly aukward; and even old ones, that have through any Defect been confined to their Neſts, when firſt they attempt to ſkim through the liquid Air, ſwim therein but very uncouth, to what they do that have been taught to, and have buoy'd up themſelves on their Quills a long Time. But as the Widow's Mite was accepted, not becauſe of its Value abſtractedly conſidered, but on account of the good Intent with which it was offered; ſo permit me to hope, that this weak Effort of mine, which is done with the ſame good Intent, will meet with the like Reception.*

Nothing but the great Neceſſity that there is for all that are concerned with Carriages, to have their Eyes opened, (where Prejudice have not ſealed them together, and made it impoſſible) could *have embark'd me in this Undertaking.*

As it is intended for the Uſe and Benefit of the Carrier and Farmer, I have purpoſely avoided (even where they might have been uſed) all technical Terms, ſo that I may the better attain the End I aim at, namely, the enlightening their Underſtandings in ſuch a Manner, as that they may be fully convinced that the Sort of Wheels I propoſe the Uſe of in the following Work, are infinitely the beſt that ever were, or perhaps ever will be invented.

I might go on, according to the Cuſtom of Scriblers, with a long Detail of what they are to be entertained with, in the following Work; and like them, give you ſuch an Abſtract of it, as would render the reading the enſuing Treatiſe partly needleſs. A little Jerkin to cover the Nakedneſs may do well, but to load a Book (much leſs a Pamphlet) with a long Preface, ſo as it can hardly waddle under it, is like arming young David *with a Coat* *of Mail; and the Book might ſay of the Preface as He did of his Armour, I cannot go with theſe; and ſo put them off again. And as* David *fought againſt the Giant, and overcame him with ſo ſimple a Weapon as a Sling, ſo I entertain ſome Hopes, that the following Work, dreſſed in this ſhort Doublet, will repel and drive out of the Minds of its Enemies, all Rancor and Prejudice, and reconcile them to the reading the following Sheets; which if it does but do, or if it can but overcome the Giants, namely thoſe who are obſtinately ſet upon purſuing their own Notions, right or wrong, the reſt will be as eaſily gain'd as the* Philiſtines *were defeated, when they ſaw their Champion ſlain.*

I would not be underſtood as if I had no Prejudice or Obſtinacy of my own; no, I know that none of us are exempt from it; but then I ingenuouſly declare, that it is not ſo inveterate, as that no Reaſon or Argument can work

work on, or prevail over it; ſo far from it, I am glad to be convinced, where it is done with Candor and good Nature, which ſhould be the inſeparable Concomitants of Advice, if the Adviſer intends his Inſtruction to be of any Service.

One Thing, I think, is neceſſary to obſerve, which is to aſſure the Reader, that I always make it a Rule in all my Calculations, be they of what Kind ſoever, to take more into the Conſideration than for the moſt Part is, or can be true, in order to conclude the more ſtrongly and undeniably upon what is true; ſo that I will venture to ſay, that what either by Demonſtration or otherwiſe, is made out in the following Work (excepting thoſe Errors which may have crept in, through my Want of Time, a more extenſive Knowledge, and a proper Apparatus for ſome or all the Solutions) is ſo.

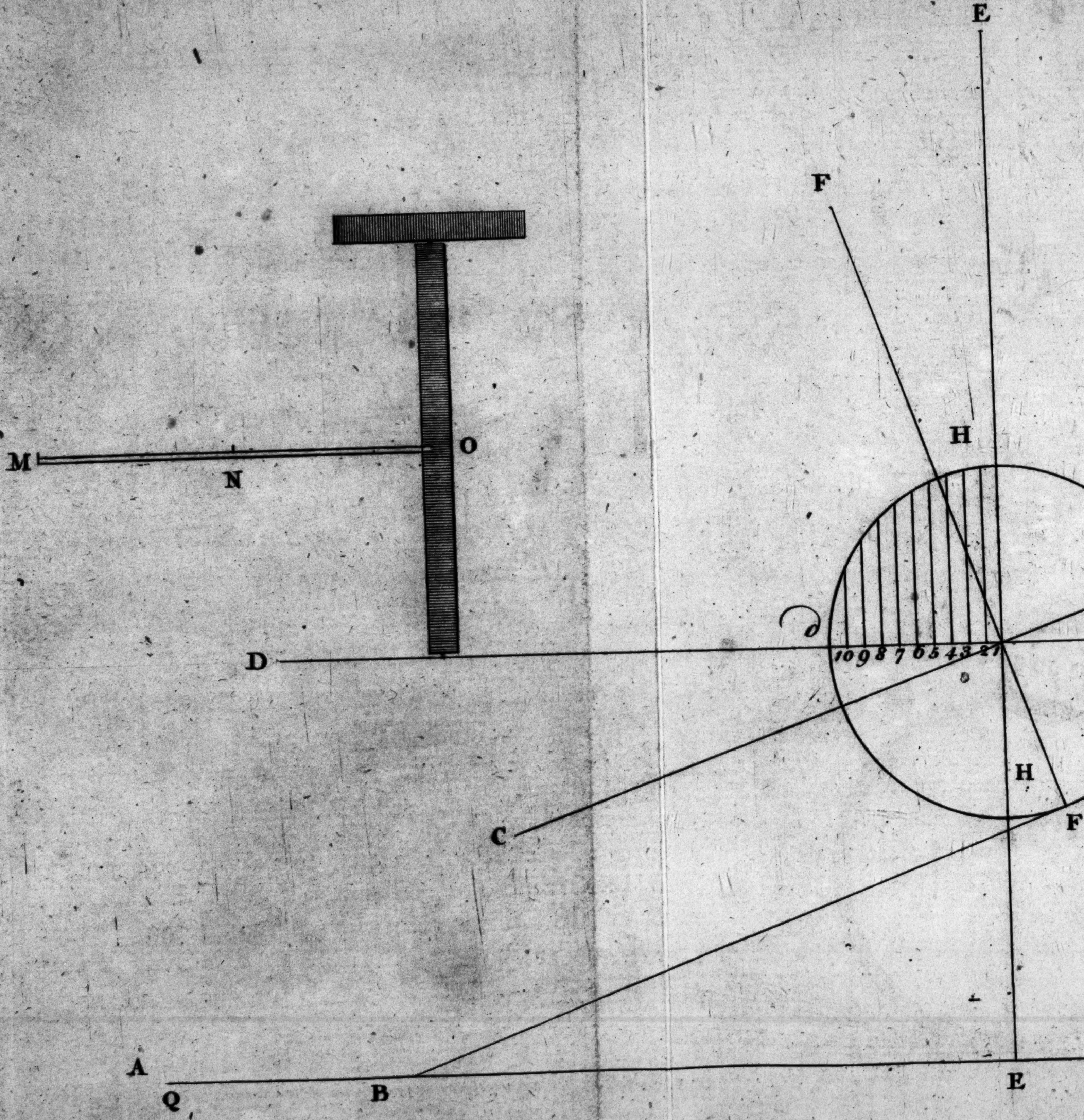
I have one Thing to beg of my cour-

teous Reader, that he will be ſo candid as not to condemn me for my good Intention; but if he ſhould happen not to be ſatisfied with what I have advanced, or rightly ſee into ſome of my blundering (yet I hope true) Demonſtrations, as he could wiſh to do; that he will be ſo good as to put this Work into the Hands of any good-natur'd underſtanding Farmer, his Neighbour; (for it is chiefly for their *Benefit that I have taken this Pains) who perhaps may reconcile any of the Doubts he may have about it.*

Before you can gain Peoples Aſſent or Conſent to any Thing, I know it is neceſſary to ſatisfy their Underſtanding; which if the following Eſſay can but bring about, and reaſon them into a general Uſe of Broad High Wheels, I declare it will be all the Satisfaction that is hoped for by

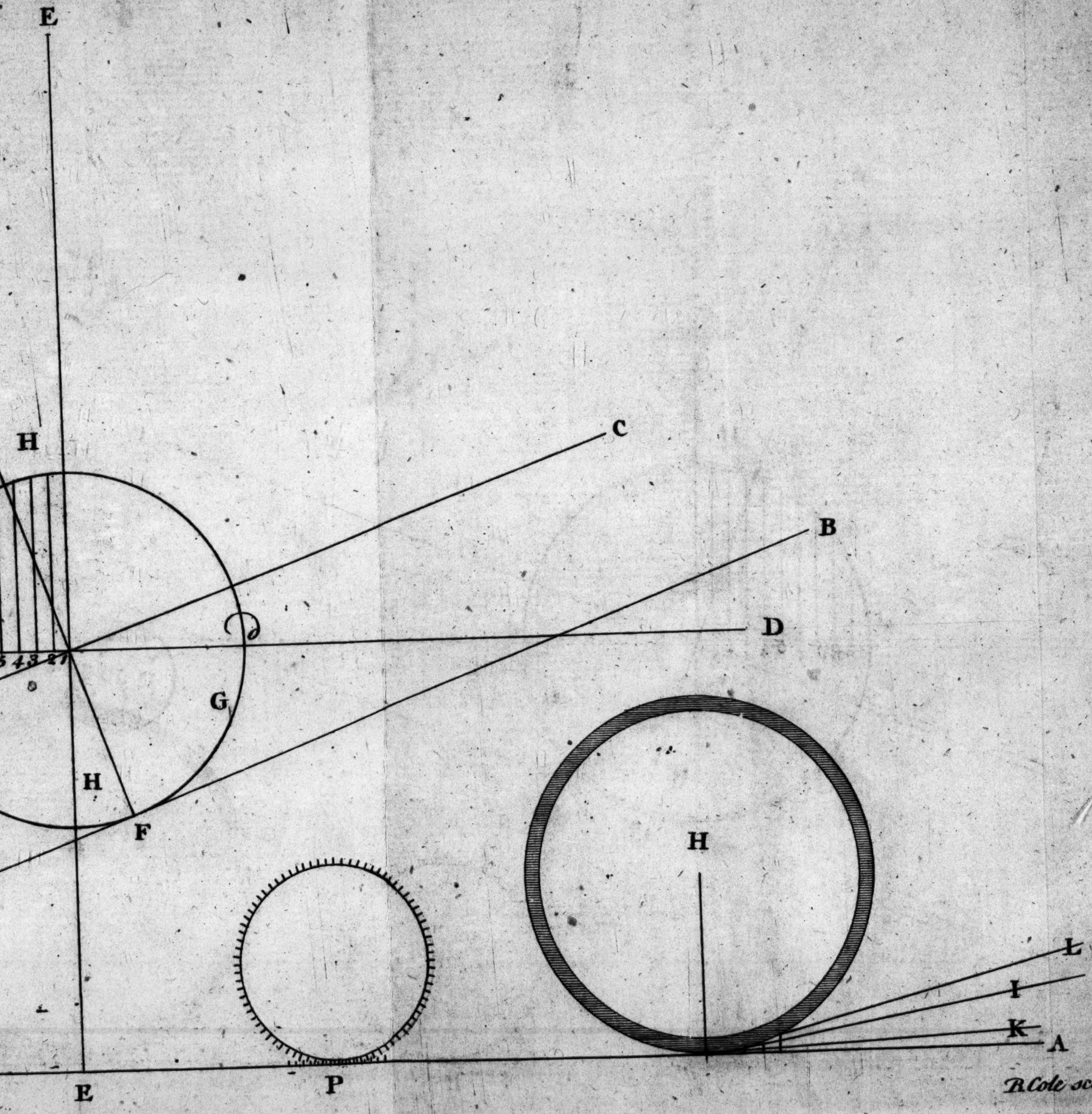
Your moſt obedient,
and moſt humble Servant,

Moses Wickham.



E
F
H
M
N
O
D
10 9 8 7 6 5 4 3 2 1
H
C
F
A
Q
B
E

To face p. 1.



R. Cole sculp.

THE

UTILITY and ADVANTAGES

OF

Broad High Wheel-Carriages.

AS it is the Duty of every Man to do any Thing, which he is perſuaded is for his Country's good, I hope every candid Reader, will look on this Eſſay of mine in that Light; and if he does me Juſtice, will ſuppoſe, (which is the Truth) that, that was the ſole Motive of this Undertaking.

I acknowledge that before the Act commenced for enjoining the Uſe of broad Wheels, (as I have no immediate Concern with Carriages) I did not once think of it; ſo cannot have the Pleaſure of thinking a Thing ſo generally beneficial to the Nation, and to Farmers and Carriers in particular, was of my hitting off; but will give the Praiſe to whom it is juſtly due, *viz.* to our wiſe Legiſlature.

But after I had found that an Act had paſſed to enforce the Uſe of broad Wheels, I began to conſider more maturely about it; and it ſoon appeared to me, to carry in it all the moſt legible Marks of Utility, Intereſt, and Advantage; but notwithſtanding which, I heard it ſo generally exploded, and condemned, ſome ſaying ſuch Wheels would be ſo cumberſome, there would be no uſing them; others ſaying there would be vaſt Diſadvantages from the Uſe of them againſt Hills, in narrow bye Roads, *&c.* which induced me to think more ſeriouſly of the Matter, than I fear they have done; and from thence have been led (with Submiſſion) to demonſtrate ſome of the Advantages, which muſt indubitably ariſe from the Uſe of ſuch Wheels. I have indeed preſumed to add Height to their Breadth; and I hope what I ſhall ſay in the following Pages will be ſatisfactory to every one; and that by it, they will be fully convinced, that Height will be as advantageous in one Reſpect, as Width can be in the other. Had I Time, Fortune, and proper Abilities, I would have ſuch an Apparatus as ſhould convince the moſt obſtinate and gainſaying Part of Mankind; but as it is otherwiſe, pleaſe to accept of my honeſt, tho' mean Endeavours in what follows.

And firſt let A A repreſent the Horizon, BB the Acclevity of an Hill, that makes an Angle of 20 Degrees with the Horizon; let CC be a Line parallel to the Hill BB; and DD a Line parallel to the Horizon AA. FF and EE two Perpendiculars, EE perpendicular to the Horizon, and FF perpendicular to the Aſcent of the Hill. Let G be a Wheel, whoſe Diameter we will ſuppoſe 5 Feet, or 60 Inches; (which is near a Mean between the fore and hind Wheel of a Waggon) then the Circumference of that Wheel or Circle will be 188.5 Inches nearly. Now F is the Point of Contact, or that Point of the Wheel that touches the Ground as it aſcends the Hill; whereas, if you ſuppoſe the Wheel to drop down by the Perpendicular EE, till it reſts in the Point E on the Horizon AA; 'tis evident that that Point of the Wheel, where the Line EE paſſes through, would be the Point that would reſt on the Ground; which would be 10.2 Inches backwarder than what it now is; the ſame Difference holds with Reſpect to its oppoſite ſimilar Segment H.

Now let us ſuppoſe the two Segments H H, each of which takes in about 10 Inches of the Circumference, both which will be 20 Inches, and let us ſuppoſe that one Inch

in

in the Circumference of a broad Wheel to weigh a Pound heavier than the narrow, (which is more than it really can be,) the Difference would then be 20 Pounds each Wheel; which would amount to 80 Pounds in a four Wheel Carriage, which if *true* would be no ſuch a mighty Matter; but the Difference is far from being ſo much, as I ſhall ſoon demonſtrate.

For ſuppoſe, any Part of the Weight to be at the Point *d*, where the Circles Radius is ſuppoſed to be divided into 10 equal Parts, then the Weight would be but as in the Margin,
1.0 which is but 5.5 Pounds; and
.9 then the whole Difference would be
.8 but 44 Pounds. But it is evident,
.7 that no Part of the Weight can
.6 reach beyond that Point of the
.5 Circle which is paſſed through by
.4 F F; for let the Wheel be ſuſpended
.3 by its Axis of any Plane howſoever
.2 inclined, it will be at Reſt;
.1 for the Points *d d*. being cut by
—— the horizontal Line D D, will always
5.5 be in Equilibrio; and ſo of
.8 any other 2 Points that are oppoſite:
—— So that what we have to aſcertain
44.0 is, what the Weight of thoſe 2
Segments is; which are made by the Perpendicular F F, and E E; now, the

Perpendicular F F, cuts the Circle between the fourth and fifth Diviſion of the Radius, where a Pound Weight would be but .45 of a Pound, ſo that in Reality the true Difference would be but 1.35, as in the Margin, and the Difference in the four Wheels would be 10.80, which would be quite imperceptible. I hope what has been ſaid, will ſufficiently obviate the Objection, that broad Wheels go heavier againſt Hill than narrow ones. I ſhall next make it appear, that the Advantages which will accrue from the Uſe of Broad Wheels, on any Sort of Surface whatſoever; are more than enough to counter-ballance, all the Inconveniencies that poſſibly can ariſe, from the Uſe of them.

.45
.35
.25
.15
.05
.04
.03
.02
.01
———
1.35
.8
———
10.80

First, common Senſe tells us, that narrow Wheels muſt cut into, or make a greater Impreſſion on any Surface, than broad ones can. I imagine the Difference muſt be more than the Difference between the Breadth of the narrow Wheels and broad ones; (which for Want of a proper Apparatus I cannot rightly determine) but were it only that, the Impreſſion would be but one third of that which the narrow ones would make.

Now by giving the Objector, all the Advantage in the Diſpute he poſſibly can have, (for the ſofter the Surface is, the more have the broad Wheels the Advantage of the narrow ones) we will ſuppoſe the Road ſo hard that the narrow ones cut in but one tenth of an Inch (which conſidering the Earth's Elaſticity, I queſtion whether it can be the Caſe any where, Rocks excepted) then the broad Wheels will cut in but one third of that tenth.

The tenth of an Inch may ſeem (perhaps) to thoſe who do not ſeriouſly think about Things, to be ſo inconſiderable, that the Difference between that, and one third thereof, not worth our Notice; but if they conſider, that tho' it is but a tenth of an Inch, yet it makes a conſiderable Angle with the Horizon.

For tho' the Wheels of Carriages ſeem to touch the Ground for near the Length of a Foot, and where the Surface is not ſo hard, much more; yet, in Truth, a true Circle on a true horizontal Plane, ſuppoſe it impenetrable, would touch that Plane but in one minute Point; then if we ſuppoſe a Subſtance placed before ſuch a Wheel equally hard, which is to ſuppoſe what is the real Fact, we ſhall then find, that the conſtant riſing before the Wheel, will make a conſiderable Angle with the Horizon; which is every Moment to be ſurmounted, ſo that the Wheel H will be going continually up Hill, as it were like the Line J.

Now ſuppoſing the broad Wheel to make one third of the Impreſſion the narrow one makes, (which, tho', I have no Apparatus wherewith to demonſtrate it, 'tis very obvious to me it does not) then the broad Wheel would move in the Line K. which is one third of the Angle the Line J makes with the Horizon.

But if we ſuppoſe (which is very common out of the Turnpike Roads) that the Wheel H cuts into the Earth ſometimes half way the Fellows, ſometimes the whole, and very often much more; what will the Angle be that the Line the Wheel moves in makes with the Horizon?

Were it to cut in but good Part of the Fellows, the Wheel would always move in the Direction L. which makes an Angle of about 15 Degrees with the Horizon; and is, as if you were continually going up a very ſteep Hill.

To illuſtrate more fully what I have been obſerving, and to make it obvious to the meaneſt Capacity; let us ſuppoſe, a Chaiſe, or any other light Carriage, which a Man is able to pull after him, and let us ſuppoſe it to be on a ſmooth, well mow'd Bowling-Green; at the Side of which let there be a perfectly level and ſmooth Piece of Pavement. Then let the ſaid Carriage be on the Green at ſome Diſtance from the Pavement, and let a Man take hold of the Shafts and draw the Carriage after him over the Green to the Pavement: he will eaſily perceive that as ſoon as the Wheels are upon the Pavement, that the Carriage will move forward with much leſs Force, than when it moved on the Green; for which there can be no aſſignable Cauſe poſſible, than what I have already aſſigned in the Motion of the Wheel H. *viz.* that little Angle which every Wheel does as it were move in; and is always in Proportion to the Hardneſs or Softneſs of the Ground it moves on.

Now if the Difference is ſo much, as to be perceptible in the laſt mentioned Caſe, where (perhaps) you cannot ſee any Manner of Impreſſion the Chaiſe has made on the Green: I leave any one to judge what that Difference muſt be, where the Impreſſion is perhaps 20, or 100 Times as much. I don't ſpeak this by way of begging the Queſtion, having been myſelf well ſatisfied of the ſame by Experience.

As I am now treating of broad Wheels and Wheel Carriages in general, permit me to beg your Patience for a few Moments, while I endeavour to prove, that the Size of our Wheels in general, are not ſuch as are the moſt advantageous.

I hope I ſhall make it appear, that the larger the Wheels of any Carriage are, the leſs Force is required to move, or keep in Motion ſuch a Carriage.

And the Difference (if I conceive right) is in an Arithmetical Proportion to the Wheels Diameter: *viz.* if the Wheels of a Carriage be 60 Inches Diameter, the ſame Carriage will be moved, or kept in Motion, with half the Force that would be required to move, or keep in Motion the ſame Carriage with Wheels of 30 Inches Diameter. You'll pleaſe to deduct one half the Weight of the empty Carriage (for in the other Caſe I have ſuppoſed it loaded,) for the Weight of each Carriage, in Order that they may be equally ſtrong, we will ſuppoſe equal in Weight, and alſo, an Allowance for the Angle of Impreſſion, if it may be allowed that Name; neither of which has any Thing to do in the Queſtion here meant: let theſe Allowances be made I ſay, and I doubt not but what I have advanced will hold good in Practice, as I am ſure it does in Theory.

I ſhall firſt illuſtrate what has been ſaid by a ſimilar Caſe; and then proceed to an ocular Demonſtration.

Firſt then, let us ſuppoſe, the Poſt or Piece of Timber O, to be the Poſt or Centre Piece of Timber of a Malt Mill, &c. And likewiſe let us ſuppoſe a Horſe drawing at the Point N, equal to 100.

Now, if we ſuppoſe the Horſe moved to the Point M, and there drawing with the ſame Force, he will there with that Force move 200. Allowance always being made for Friction, which is the ſame in all ſimilar Caſes, and has nothing to do in our preſent Buſineſs.

If there are any ſo blind thro' Prejudice, as that he will not believe me in any Thing that I have ſaid, I would have him, the firſt Time he thinks of it, when he ſees a Mill which is work'd, or turn'd according to my Deſcription, go to it, and place himſelf about

bout the middle of that Pole the Horſe is uſually fixed to, in order to work the ſaid Mill; and there let him move it round if he can; then let him go to the End of the Pole, and there endeavour to move it round; and I fancy he will ſoon be ſatisfied of the Difference, by the great Eaſe he will find himſelf capable of moving it at the End, to what he was when in the Middle.

Now, I imagine the Earth's Surface, or that Part of it, which the Wheels of a Carriage *touch*, or *lay hold* of, is to the Wheels and Load, as the Horſe is to the Mill.

And in order to prove that it is ſo, let us ſuppoſe for Demonſtration's ſake, a Carriage with Wheels like the Wheel P, and then ſuppoſe the ſaid Carriage on a moveable Plane A A. To make it the more obvious, we will imagine the Wheel and Plane to be furniſhed with Coggs, or Teeth, to lay faſt hold one of another; and let us ſuppoſe the Carriage to be fixt; and the Plane, or Road moveable, (either of which would bring the Carriage to its deſtin'd Place) by ſuppoſing Pieces of Timber let down from above, which keep the Waggon from moving this Way, or that Way; and let us ſuppoſe the Carriage, or Waggon ſo fixed, to have 40 Hundred Weight on it. But to make you the more ſenſible of what I am about to prove, we muſt ſuppoſe the Piece or Pieces of Timber ſo let down, and fixed to the Waggon as to ſlide in *Grooves* or *Sockets*, ſo that the Waggon may be *kept* to the ſame *perpendicular Point*, without taking off, or adding to the Weight or Load.

Now, let us ſuppoſe the Wheels of the ſaid Waggon to be 36 Inches Diameter, and that Horſes are ſhut, or put on to the End of the Plane A, at the Point Q; and let them be ſuppoſed to draw, in order, to move the Plane on which the Waggon reſts equal to 800. Now let us ſuppoſe the ſuſpended Waggon to have the Wheels of 36 Inches Diameter taken off, and Wheels of 72 Inches Diameter put on in their Stead; you will then find, that the Plane A would be moved by the Horſes at Q. by the Force of 400. only, when the Allowances which I have before taken Notice of, are made. The Reaſon is *evident*; theſe *Wheels* being twice the Diameter of *thoſe*, they muſt certainly have twice the *Power*.

From what has been ſaid, I think it is evident that the broader and higher the Wheels of any Carriages are, (in Reaſon) the more advantageous they muſt be.

Hay from Meadows (which in the Weſt of *England*, where they are artificially water'd, are often very ſoft) might be brought from thence with one Horſe better than four, and with one Quarter of the Trouble, and Expence; conſidering the *Wear* and *Tear* of Horſes and Carriages, and the Time which is extraordinarily ſpent in getting Crops off the Ground, by the preſent Method we make Uſe of.

How often have I ſeen our preſent narrow Wheels cut in, in thoſe Meadows, half Way up the Spokes: and ſometimes the Surge, with which Wheels drop into a Water-courſe, ſtrikes in up to the Nave of them. Now were the Wheels broad, and ſix Feet Diameter, no ſuch Thing could poſſibly happen; unleſs you ſuppoſe the Ground ſo ſoft, as that the Horſes themſelves could not go upon it. And when the Waggon has been ſo ſet, what *Time* have I ſeen loſt? how many Horſes Shoulders ſlipt, ſprain'd, or made uſeleſs? how many Harneſſes torn in Pieces, and Waggons ſpoiled?

But this is not all, the Meadows and Fields are much damaged by our preſent narrow Wheel Carriages: for notwithſtanding Dung, &c. (as you'll perhaps ſay) may be carried and laid on the Land in the froſty Weather; I grant you it may; yet to be tied down to the doing it at one particular Time, may often be a Diſadvantage to the Farmer, by interfering with other Buſineſs, which may be of more Moment than the carrying out the Dung or Compoſt at that Time; but he is forced to do it then, knowing it to be impracticable at any other Time.

But here is one Thing more, wherein the bad Conſequences and Diſadvantages to Farmers in general, by the Uſe of narrow Wheels, which demand our Attention more than any Thing I have yet ſaid, *viz.* that it is often the Caſe, that you are obliged to go into your Fields and Meadows when they are very ſoft or rotten; Corn muſt be fetched out of the Field when ripe, let the Ground be ever ſo ſoft; and the Hay muſt be carried from the Meadows, when properly made, tho' the Grounds on which it grew, be very wet; which are many Times cut into ſuch deep Ruts, and are poach'd to ſuch a Degree, as to make them look like rugged Lanes trod to Pieces with Cattle, and worn out with Carriages; all which, or the greateſt Part, may be prevented by the Uſe of broad and high Wheels.

For, by the Uſe of broad and high Wheels, it is evident, that a Carriage may go where Horſes can; and bring off Corn, Hay, *&c.* with the utmoſt Eaſe.

The ſmall Water-courſes, which in Meadows that are artificially watered, are very numerous, may be croſſed without any Difficulty; for two very obvious Reaſons; one is, that that Part of the Wheel which reſts on the Ground cannot fall ſo deep into a narrow Cut in the Ground, becauſe it is a larger Circle, and the Surge with which they drop into thoſe Water-courſes, could not have the Effect it now has, by cutting in ſo deep, by reaſon of the Breadth and Largeneſs of the Wheels.

In ſhort, ſo many are the Advantages that would accrue to every Perſon who makes Uſe of Wheel-Carriages, that I make not the leaſt Doubt, but if they once get into the Uſe of broad high Wheels, they would find them come ſo eaſy after the Horſes, that were the World as ſuperſtitious and idolatrous as it was ſome Centuries paſt, they would be apt to deify the Perſon who firſt perſuaded them into the Uſe of them. I no more doubt but that three Horſes, take Fields, Roads, and Seaſons in general, would be

able

able to fetch more Corn, Hay, *&c.* with ſuch a Carriage from the Field, than four Horſes could do in the ſame Time with our preſent narrow Wheels, than I doubt whether three Men could drive any aſſigned Quantity of Rubbiſh, *&c.* over a ſoft Meadow half a Mile wide, with our common Wheel-barrows, in leſs Time than four Men could drive the ſame Quantity away with the ſame Sort of Wheel-barrows, only they ſhould have Wheels to them ſo narrow and ſharp, as to be like the Wheels of the Ploughs with which we plow our Land.

Our Bye-Roads (were ſuch Carriages us'd) being once made fit for the Reception of them, would be as much better than they are now, as the Great Roads are now better than the Bye-Lanes. How common is it to ſee our Bye-Lanes and Roads for the moſt Part, with ſuch deep Ruts and Holes, as to be almoſt impaſſible; nay many of them in the Winter are abſolutely ſo.

From hence appears the Groundleſsneſs of that Objection which I have heard ſome People make to broad Wheels: What ſhall we do with them, ſay they, in our narrow Lanes? I ſay, that were broad Wheels general, they would be of more real Advantage to People in general, who frequent thoſe Bye-Roads, than they would be to the public Roads in particular.

If our Bye-Roads were made fit for the Reception of Carriages made on my Plan, *viz.* Wheels 7, 8, or 9 Inches broad (the Tire perfectly flat;) and of about ſix Feet Diameter, which for the moſt Part little more than the Duty, which is required by Act of Parliament, would do; we ſhould ſoon ſee the happy Effects of it: thoſe Roads would be paſſible at all Times and Seaſons, or at leaſt, taking any particular Time or Seaſon, they would be much more paſſable than now, (eſpecially the Winter Seaſon) I don't in the leaſt doubt, but that, taking every Thing on an Average, three Horſes would be then able to do more than four are now.

It may perhaps be objected, that our Carriages, were they made according to thoſe Principles, would be ſo high and unweildy, that one ſhould abominate the looking at them; and not only ſo, but they would be liable to overturn much ſooner than theſe we now make Uſe of; to which I anſwer, that they would be ſo far from overturning the ſooner, that were our Carriages half a Foot or nine Inches higher than they are, if they had broad Wheels, ſuch Carriages could not overturn ſo eaſily as a narrow Wheel one of the preſent Height. The Center of Gravity could not be loſt ſo ſoon with a broad Wheel-carriage as with a narrow one, for that very Reaſon that it is a broad Wheel-carriage.

But to give you a Proof of what I here advance, and that every unprejudiced Mind may be as well ſatisfied as myſelf, let any one who cannot ſee into the Reaſon, or through Prejudice will not; I ſay, let ſuch a one take a Log of Wood, ſuppoſe two Inches thick, and four Inches high, and let it (if it will not lye faſt of itſelf) be faſtened to the Ground; let it be long enough for the Breadth of his Feet, then let any one ſtand on the Log of Wood with his Feet croſs it, then let any one hold a Staff, *&c.* at ſome Diſtance before him, moving it forward as he reaches after it, till it is moved to that Point, beyond which he cannot reach, without tripping forward off the Log; then let the Log be taken away, and let the ſame Perſon ſtand in the ſame identical Place which the Log lay on, and let him bend himſelf forward to reach the aforeſaid Staff, and he will find that he can not only reach the Stick, but much beyond it, without falling forward. The Reaſon is, the Log being but two Inches broad, the Center of

Gravity muſt fall ſomewhere on the upper Surface of the ſaid Log; which as he bends forward, muſt move forward alſo, but can be no forwarder than the fore Edge, or that Part of the Stick which is next the Staff he reaches after. Now the Foot being much longer, the Center of Gravity may be much more varied than what the Space of two Inches will admit of; as he bends forward, it may be near the Tip of the Toe, and if backward, near the Point of the Heel. So in the Caſe of broad Wheel-waggons, if they ſhould go, or be on Ground which is ſidelong, as it is called, as it ſhould get more on one Side, it would begin to preſs on the outer Edge of the lower Wheels, and would bear on the outer Edges only; before the Waggon could overturn; and it is hardly poſſible in any Road where Carriages are uſed to be drawn (excepting Accidents) for ſuch a Carriage to overturn. Now with narrow Wheels, in the like Caſe the Center of Gravity may ſoon be loſt; for as ſoon as the Weight is on the lower Side, there cannot be that Advantage of the Center of Gravity moving farther out, as it would do with the broad Wheels; and not only ſo, but the Weight on the lower Wheels will preſs them into the Earth, and ſo the lower Part of the lower Wheels would be ſtill more under the Bed of the Waggon upon that Ac-

count

count too; ſo would be more liable to be overturned.

I ſhall next ſpeak a Word or two concerning the Advantages of large Wheels; for altho' I have ſaid enough to ſatisfy every unprejudiced Perſon already, where I demonſtrated the Advantages that would accrue to us from the Uſe of large Wheels, yet I did not there aſcertain what the Advantage would be to a common Waggon or Carriage in particular.

Now if 5 Feet be the mean Diameter of our preſent Carriage-wheels (tho' I believe they are hardly ſo much) then the Radius is 2.5 Feet, which we will ſuppoſe cannot be moved but with five Horſes; that is five Horſes to 5 half Feet; now by adding an half Foot to the Diameter of the Wheel, we give it a Power equal to that of the Strength or Draught of one Horſe, and conſequently four Horſes would draw as much with thoſe Wheels as five would with theſe; for if the Weight of a Steel-yard at 2.5 Feet from the Center, will hold in Equilibrio 50 Pounds, if you move it half a Foot farther from the Center, it will there ſupport 60 Pounds in the ſame Manner, which is a ſimilar Caſe; only in the Carriage Allowance is to be made for Friction, and the dead Weight of the Waggon, which is the ſame in, or with all Loads that are laid on them.

The happy Effects that would ariſe from the Uſe of ſuch Wheels are innumerable: But if any Perſuaſions will avail, if any Proofs will convince, or the Intreaty of any diſintereſted Perſon move you, be perſuaded to uſe ſuch Wheels as I have been endeavouring to convince you; and as I myſelf am perſuaded are infinitely the beſt, tho' there were no Act of Parliament to enjoin it you. If you could once be perſuaded to make Trial of it, (I mean in general) you would ſoon be ſatisfied of their Utility; I doubt not but the Satisfaction would be ſuch, as that if you looked upon me as the ſole Author of bringing it about, you would not know how to careſs me enough. I ſuppoſe I ſhould be deified by you; or, at leaſt, ſhould ſtand in black Letters in your Almanacks on the 20th of *May*.

But to make a ſerious Matter of it, I ardently wiſh I may live to ſee the Time when there will be no Carriages (except Wheelbarrows) but what will have Wheels broad and high, ſuitable to the Weight they are to carry; which, if I ſhould, I hope God will help to ſupport me under the exquiſite Pleaſure I ſhall have, by ſeeing ſo uſeful and advantageous a Proſpect, for fear I ſhould be exalted above Meaſure.

I hope I ſhall not in this Undertaking be cenſur'd, as proud in writing obſtinately in my own Opinion; or led by any Partiality or Intereſt; when I ſeriouſly and ſolemnly declare, I am not led by any one of theſe Motives, any farther, than as every Man who hath his Country's Good at Heart, would engage in any Undertaking, that he thought his Country might be bettered by. And from hence, I hope that every one who prefers the Public-good to his own private Intereſt, will ſee the good Intent of this Diſſertation: whoſe Eſteem (or bare Silence in forbearing to cenſure me) if I can but gain the oppoſite Party, will give me but little Trouble, nor do I think they ſhould give any to the greateſt Patriots; much leſs to me, any farther than that they may be concerned, that there ſhould be ſuch Men.

The laſt Perſuaſive I ſhall make Uſe of, (and which if it fails all others may be allowed ineffectual) is the Intereſt, or Advantage, the Uſe of broad high Wheels, would be to every Individual. Any thing would mend the Roads, (comparatively ſpeaking) the refuſe Stuff, that lays about in many Places as uſeleſs, would then laſt longer than our beſt Ballaſt does now. Not that I would preſcribe the Uſe of ſuch, where other may be had; for it muſt always be allowed, that the more ſolid any Materials of this Kind are, the more durable they muſt be; and conſequently go the longer without Reparation. Our Roads, particularly Bye-Roads, Lanes, *&c.* would not want mending twice in an Age, (of which I am confident,) and you, if you follow my honeſt and hearty Entreaties, will find by happy Experience.

All, or by far the greateſt Part of the Expence we are now at, would ceaſe; Turnpikes would vaniſh, be no more, and we ſhould be, what we always boaſt ourſelves, a *free* People. In that Reſpect every one, if he made any Conſcience of Things, or had any Mercy for Man or Beaſt, would find he had Liberty, and was able to carry as much on any Road, publick or private, as in Reaſon he could deſire. And to Man who is a free Agent, the Advantage of not being laid under any Reſtraint, is in my Opinion not the leaſt Part of his Pleaſure. For to be compelled to a Duty, tho' manifeſtly to our Advantage, that Reſtraint too often blinds our Eyes, or better Underſtanding, and makes us act in Oppoſition thereto; tho' at the ſame Time, we run counter to our own Intereſt.

Notwithſtanding, I thought to have brought this Work to a final Period in the above Paragraph; I know not how it is, but I find myſelf in the like Caſe to the Traveller, to whom every Mountain or Eminence that lays before him on the Road, terminates his View; yet when he arrives there, it only opens to him a more extenſive Proſpect; ſo I have ſo many Things occur to my Mind, that would be of Advantage from the Uſe of broad Wheels, that I cannot help taking Notice of one or two more.

That our preſent narrow Wheels cut the Roads to Pieces, and looſen the Surface thereof to a Degree much beyond what broad ones would do, is indiſputable; and conſequently, in the Winter-time muſt cauſe a prodigious deal of Dirt in the Roads, more than would be, with the Uſe of broad Wheels; for the Surface of the Earth being looſened, muſt abſorb Rain, *&c.* which being trod with Cattle, and as it were continually ſtirred, with ſomething or other, that, tho' the Road ſhould lay with a Deſcent both Ways, yet even in the Middle of it, you often meet with Sludder, *&c.* which by the bye helps to invalidate, or break the

Force of one of the Objections, that the Oppoſers of broad Wheels make Uſe of, *viz.* the broad Wheels, ſay they, being ſo much larger, gather a proportionable Quantity of Dirt; which we will grant them. Now it is obvious to me, that on my Plan (if I may preſume to call it ſo) there would not be one tenth Part of the Dirt in our Roads in general, as there now is; and conſequently, tho' we ſhould allow that the broad Wheels gathered twice as much Dirt as the narrow ones, even then the broad Wheels would have five Times the Advantage of the narrow ones; there being but one Part in ten for them to gather up.

I have already taken Notice of the great Difference there is, between a hard Surface and a ſoft one; with Reſpect to the Penetration that muſt neceſſarily be made on the latter by any Sort of Carriage, than what can be made on the former; and alſo that the Looſeneſs of the Surface of Roads in general, are occaſioned chiefly by their being plowed up ſo much, with narrow Wheels; I have only this to obſerve here, that even Mud and Dirt, nay, even Water itſelf, is an Obſtruction to the Motion of Carriages; and of Courſe, even that (not to take Notice that the Places where it lays muſt be ſoftened, and therefore let the Wheels in farther, than they otherwiſe would penetrate,) muſt make them come heavier after the Horſes. If any one doubts of the Truth of what I have advanced, let him take a light Carriage, and draw the ſame croſs a Pond which hath a firm and plain Bottom, only very ſoft Mud; or if you will, Water only, and I fancy he will be convinced that it comes harder after him, than when he draws it on the like Plain, or Surface, where there is no thin Mud, or Water to obſtruct the Motion.

You will ſay perhaps, that theſe are ſuch very inſignificant Things as not to be worth our Notice; but with your Leave, that is only ſaying, what the ſoft-headed Son ſaid to his Father, who ſent him to purchaſe for himſelf an Eſtate. (For the Truth of this Digreſſion, *ſee Hill*'s *Arithmetic*) I have found one, ſays he, that will come on very eaſy Terms; the Gentleman who owns it, tells me there is a Mannor-houſe belonging to it, with ſixty four Doors; and that I ſhall have the whole Eſtate, on ſuch eaſy Terms, as only to lay one Barley-corn at the firſt Door, two at the ſecond, four at the third, and ſo on, doubling the Number of Barley-corns 'till I come to the laſt Door. The Son thought (as indeed it is) a Barley-corn, ſuch a ſmall trifling Thing, that a Load or two, muſt at leaſt be ſufficient, for his Purpoſe. But the wiſer Father ſoon told him, that if this Globe of Earth were a Ball of ſolid Gold, and that Ball were to be coin'd into Guineas, and each to paſs for twenty-ſeven Shillings, it would not buy Barley enough at two Shillings *per* Quarter to pay for the ſaid Eſtate. I only inſtance this by the bye, to ſhew you that the moſt trifling Things, when there is an Accumulation of them, may be a very great Obſtruction. So here, tho' every Hindrance may (to thoſe who will ſhut their Eyes at Noon, and ſay 'tis Midnight) appear inſignificant; yet all the Diſadvantages which I have taken Notice of, put together, will be very conſiderable, and have ſome Weight with the thinking Part of Mankind. And I will be bold to ſay, that every Obſtruction which I have taken Notice of (tho' I may have miſs'd many) have been ſufficiently demonſtrated, or have carried their own Evidences with them, in ſo glaring a Manner, as to need no farther Illuſtration. What I have ſaid of Dirt, Water, *&c.* in the Winter, holds good alſo in the Summer, with reſpect to Duſt; for it is known to every one, that all that looſe Dirt and Sludder, which obſtructs Carriages in the Winter, is all, and more than all, turned to Duſt in the Summer; and I am well perſuaded is a greater Obſtruction, if it be abſtractedly conſidered, than in the Winter. But this is not conſider'd by many, becauſe upon the whole they find the Roads to draw much eaſier than in the Winter; but this ariſes from the Hardneſs of the Earth's Surface in the Summer, to what it is in the Winter; not from the Abſence of Water and Dirt. And I here appeal to every one who goes with Carriages, or knows any Thing of the Matter, whether they don't find a great Difference between a looſe, ſandy and duſty Road, and a hard chalky, or clayey Way (in the Summer-time) which are free from both. I make no doubt, but that four Horſes would draw more on a Road ſo free from Duſt, *&c.* (as our Roads would be with the Uſe of broad Wheels in general) than five can do by our preſent Method.

Were it not that I would chiefly confine myſelf to the pointing out the great Utility the Abſence of Duſt, *&c.* would be of to Carriages in general, I ſhould not forbear entring into a long (tho' juſt) Detail of the Advantages it would be of to every Creature that paſſeth on the Road. How ſuffocating and diſagreeable are thoſe Roads where much Duſt, *&c.* lies, to what *they* are that are free from it? How troubleſome to the Eyes, as well as diſagreeable to View, are all ſuch Roads where the Verdure of the adjacent Fields, as well as thoſe Hedges and Trees that encloſe the Roads, that are covered

with

with Duſt? How troubleſome and pernicious muſt it be to Cattle, as well as their Drivers; eſpecially Sheep, whoſe Mouths and Noſtrils are ſo near the Ground, and of Conſequence every Breath they draw, muſt ſuck in much of that Duſt their more numerous Feet have raiſed?

I muſt end ſomewhere, or elſe, as I ſaid before, the more I write, the more I have to write upon. But I flatter myſelf, that if thoſe into whoſe Hands this may happen to fall, will take but a little Pains to conſider of what I have ſaid, and note the Evidences for the Truth of what I have advanced, will be convinced of the Truth of every Article; and in conſequence of that Conviction, cloſe in with ſo great, ſo general a Good, which, if I ſhould but live to ſee, I ſhall have a ample Satisfaction in ſeeing it, as they will have Profit and Pleaſure in the Proſecution thereof.

Some perhaps may object and ſay, if there are ſuch very extraordinary Advantages to arrive from the Uſe of broad Wheels, as I ſay there are, ſurely ſome one before now muſt have diſcovered it; but if this be admitted as a Reaſon for its being diſcovered ſooner, the ſame Objection will lay againſt all other uſeful and beneficial Arts and Diſcoveries,

veries, that from Time to Time have been made through all former Ages, down to the preſent Time. But this is ſo weak an Argument, as I think needs no Refutation; for, according to this Notion, *Adam* muſt know as much of Arts and Sciences as we do now; and at any Age of the World, if any one made any Diſcovery that was not known before, the then Age might have objected to the Uſe of it, by ſaying, if what you would perſuade us to the Uſe of, be ſo beneficial and uſeful as you would perſuade us; how comes it to paſs, that it was not diſcovered before this Time of the World? But to every one that knows any Thing at all, theſe Objections will appear without the leaſt Shadow of Senſe, Reaſon, or Truth. For it is obvious to every one, even the moſt ignorant, (that are not downright Fools) that there hath been in every Age and Corner of the World, at ſome Time or other, ſomething hit of, that has been of Uſe to future Ages. And as this ſeems to have been the Caſe from the earlieſt Ages down to this preſent Time; I make no doubt, but that Diſcoveries will ſtill be made that will be of Uſe to future Generations. And this ſeems to be a Contrivance of the great Author of all Wiſdom and Goodneſs. He, knowing the Nature of Man, that as ſoon as they found a *Ne plus ultra*, hath at all Times when it hath, by his unerring Wiſdom been found neceſſary, raiſed up Men that have had Abilities and Courage enough to ſtep out of the common Path; and (tho' often with much Perſuaſion) the World hath been directed, and conſequently benefited, by their uſeful Diſcoveries.

I ſaid in Page 5, I could not determine what the true or real Difference was between the narrow and broad Wheels with reſpect to the Impreſſion the former muſt make on the Surface of the Earth more than the latter. I there ſuppoſed it to be in Proportion to the Wheel's Breadth; but I have ſince made Obſervation on the Road at the ſame Place, where a narrow Wheel and a broad Wheel-carriage paſſed me, both of which went out of the Ruts, and nearly after one another; yet not ſo, but that it gave me an Opportunity of meaſuring the Depth that the different Carriages made; and I found that the narrow Wheels cut in, at leaſt, four Times deeper than the broad ones, tho' perhaps the broad Wheel-carriages had twice the Weight on it as the other Waggon; and if it cuts in four Times as much with one half of the Weight; then the Advantages which broad Wheels have to narrow ones, are as eight to one; which ſingle Argument would, one would think, be ſufficient to induce any one to lay hold of ſo many Advantages.

I cannot but obſerve to you, that the Eſtimates now taken in order to judge of the Utility and Advantage that will accrue, or not ariſe from the Uſe of broad Wheels, as Things are now circumſtanced, muſt be very erroneous. Broad Wheels and narrow ones cannot ſubſiſt together; it is in ſome Places hardly practicable for the broad Wheel-carriages to avoid going in, or near the Ruts made by the narrow Wheels, and of Conſequence muſt come heavy after the Horſes in ſuch Caſes: But if they do not go in the Ruts exactly after the narrow Wheels, yet the Earth is ſo looſe near the Ruts, that it makes thoſe that do not look to the Bottom of Things imagine, that it is owing to the Conſtruction of the Carriage, that makes it come ſo hard after the Horſes; when the true Cauſe is, only that the Road is ſoftened vaſtly more than it would be with broad Wheels, by the frequent Uſe of our preſent deſtructive narrow Wheel-carriages.

Another Thing that helps to fix in the Minds of thoſe who oppoſe the Uſe of broad Wheels is, that they are very cumberſome, and not only ſo; but, ſay they, what muſt thoſe little Carriers and Farmers do who keep but three Horſes in all? It will be as much as they can do to draw about ſuch a Carriage, tho' they ſhould have nothing in them. To thoſe People give me Leave to obſerve, that they do not ſee Things in the ſame Light they would appear, were broad Wheels the only ones that were uſed. As Things now ſtand, they that have Boldneſs enough to ſtep out of the common Tract, and have complied with the wiſe Legiſlature, in the uſing broad Wheels, have been obliged to have thoſe Wheels bigger and ſtronger than they need to have done, in order to be on equal Terms with thoſe who through Obſtinacy (more than Reaſon) would not come into the Uſe of them. But were there no other than ſuch, it would not be long before we ſhould ſee things in a quite different Light. The Roads would ſoon become as Adamant (comparatively ſpeaking) to what they are now; and as People would be laid under no Reſtraint as to Weight or Number of Horſes, nor Impoſts or Obſtructions whatever (for in my humble Opinion they muſt, in the Nature of Things, vaniſh every one of them, and be no more) every one would then have his Carriage with ſuch Weight or Strength as beſt ſuited with his Buſineſs. If he had Buſineſs but for three or four Horſes, and conſequently would not carry ſuch Loads as they could, whoſe Farm or Road-work would anſwer the keeping more; how eaſy would it be for ſuch to have the Binding of their Wheels but a Quarter of an Inch thick, or more or leſs, as Occaſion required, inſtead of half or three Quarters of an Inch thick, and the Wood-work being in Proportion, how light (notwithſtanding their Breadth) would ſuch Wheels be in Compariſon with what are now uſed in order to carry ſuch enormous Loads. And give me Leave to tell you, that Wheels made on theſe Principles, with the Iron no thicker than what I have ſeen round the Wheels of Wheel-barrows would (as the Roads will be when theſe happy Days ſhall come) conſidering the few Jerks and Twiſts they would meet with, on ſuch Roads as muſt then neceſſarily be, laſt Time immemorial.

With the Carriages which we now uſe, if our Roads are mended, tho' with the beſt of Stuff, how do our narrow Wheels cut through it all, and keep it always looſe, ſo as to let in a great deal of Water, till what with the Wet, grinding, trampling, *&c.* that very Road which they call mended, is paſſed with more Difficulty than before, and muſt ſo remain till dry Weather comes to bind it together; by which Time it is ſo ground to Pieces, and cut into ſuch deep Ruts, that when the Paddlers have paddled in the Outſides, and reduced it to a Level, it is but a little better than Dirt, which the firſt narrow Wheel-Carriage that paſſes over it, will go near to find the Bottom of. Now I will be bold enough to ſay, that a Road being in the above Circumſtances, can be paſs'd with five Horſes, and the ſame Weight with broad Wheels, with more Eaſe than ſix can draw the ſame Load with narrow Wheels. And to convince you that I am perſuaded of the Truth of what I ſay, let any one be but at the Pains of trying the Experiment; and if he finds that his five Horſes will not draw more than ſix (ſuppoſing their Strength to be equal) this Aſſertion of mine, ſhall be a ſufficient Warrant for him to come and demand of me ten Pounds to buy him another Horſe, to enable him to get over the ſaid Road; only the Experiment ſhall be tried, ſo that the judicious and knowing Part of Mankind allow it to be true. Now if the Advantages are ſo many, under our preſent Circumſtances, what will be the happy Effects, when all our Roads are like a Sheet of Pavement. I am inclined to think, that the Difference will be as one is to two, that is, that three Horſes will be able then to draw as much as ſix can now. If I have exaggerated a little (as, till it is proved, I ſhall queſtion whether I have or no) you will pleaſe to forgive me, and be aſſured, that my Intentions are not to aggravate or miſlead Mankind, but, as far as I am capable (for their univerſal Good) to inform them.

What a lamentable Caſe is it to ſee our fine Downs and open Countries, for the Sake of a freſh Road cut to Pieces, with ten thouſand Cart-ruts, which not only ſpoils the Beauty of the Downs, but ſpoils a great deal of Graſs that otherwiſe would grow there: And if a Gentleman, *&c.* ſhould have Occaſion (whether in ſporting or otherwiſe) to croſs thoſe Roads, he muſt be a Quarter of an Hour doing that, which otherwiſe might be done in a Minute with much more Safety. Now if thoſe were once levelled, and broad Wheels to become general; it would be impoſſible, were the World to laſt ten thouſand Years longer, that there ever ſhould be ſuch Ruts again; but our preſent Carriages (ſuppoſe it levelled) would make it as bad again in half a Century.

For fear I ſhould be thought to write merely to ſwell my Pamphlet, and to enhance the Price of it, I will conclude with offering but one Inſtance more; in which I ſhall propoſe as a Pattern the Work of infinite Wiſdom. Tho' God hath abundantly diſplayed his boundleſs Wiſdom, in all that he hath created or made, yet he ſeems to have beſtowed more of his wiſe Contrivance, as the Creatures he beſtowed it on, are more or leſs noble. The moſt exalted Creature God has made on this Earth, is Man; and accordingly we find in him (beſides that of his being a rational Creature) conſidered only as an Animal, all the wiſe Contrivance that can any ways contribute towards his Well-being and Happineſs. I might take notice of his Goodneſs to us in a thouſand Inſtances; ſuch as our erect Poſture, the Form of our Hands for holding any Thing, the Situation of our Eyes, as near as may be at our upper End (if I may be allowed that Expreſſion) in order that we might ſee Danger at a Diſtance, and ſo avoid it. But without being tedious (for the Works of infinite Wiſdom are innumerable) I ſhall take Notice of the Feet of the human Species only; that we could have ſubſiſted, if our Feet ended in the Form of what we ſee artificial wooden Legs do, is out of all Doubt. But God, out of his Goodneſs, has been pleaſed to place at the end of our Legs what we call a Foot: And that he has made as broad and as long as it could be, to hold any Proportion with the Body, in order that our Weight might not force it into the Earth, and ſo make it very troubleſome for us to walk. I believe I need not ſay much to convince every one of this, who has ever walked croſs a ſoft plow'd Field, or Straw, or Dung-Barton (as many are confined to walk in the former for Hours together) who all know by woful Experience what it is to ſink into the Earth two or three Inches every Step he takes. The Foot of Man, as it is horizontal, and between three and four Inches broad, and nine or ten long, muſt cover or reſt on a much greater Quantity of the Earth's Surface, than doth the Wheels of our preſent Carriages, they not being ſo broad as the Feet of Men; and as they are Circles, if they reſt on a perfect impenetrable Plane, would not touch the Ground one tenth Part ſo much as doth the Feet of Men. Now if God has made ſuch wiſe Proviſion for the Good of Man, by giving him Feet that cover or reſt on thirty Inches of Ground every Step he takes, tho' his Weight in general is little more than two hundred Weight; how far do we fall ſhort of his wiſe Contrivance, in the Conſtruction of our preſent narrow Wheels; tho' each of theſe is to ſupport fifteen or twenty hundred Weight, and at the ſame Time doth not bear one half ſo much Ground, unleſs it be that it cuts into the Earth (as it always does more or leſs) and ſo ſeems to reſt on a greater Quantity thereof; and if it does ſo, it makes the Caſe ſtill worſe, as I hope I have ſufficiently proved in the Courſe of this Work.

We all know that God cannot err; from whence it will follow, that what he doth muſt be the beſt that poſſibly could be done; and as he has wiſely contrived that we ſhould not ſink into the Earth, or be put to more Trouble to convey ourſelves from Place to Place, than what could not be avoided; let us endeavour, as far as we are capable, to contrive all our Carriages, ſo as that they may be conveyed from Place to Place with as much Eaſe as may be, eſpecially when we are to conſider that the Beaſts which draw them, are in their Way entitled to as much Eaſe and Happineſs as we can any Way contrive for them, ſuppoſing ſuch Improvements were to be of no Advantage to ourſelves. But as the Benefits that will accrue to us are ſo many, and the Eaſe to our Cattle ſo much, let us not be one Moment longer determining whether we ſhall uſe ſuch Wheels as I have been endeavouring to prove (and I hope have proved) will be of the utmoſt Advantage; for fear ſome other Nation taking the Hint, ſhould be before us in the Uſe of them, and ſo rob *England* of the Honour of being the firſt that hit of ſo great an Improveprovement. For I make no doubt but that if any Nation makes the Uſe of ſuch Wheels general, they will ſoon find ſo many Advantages ariſe from the Uſe of them, that the Fame thereof will ſoon reach the moſt remote Corners of the Earth; and the People or Kingdom that firſt made the Diſcovery, will be applauded for it as long as the Sun and Moon endure.

As Faſhion is as prevailing a Motive to induce People to the Practice of any Thing, as any, or more than any Perſuaſion, or Reaſon whatever; I heartily wiſh that the Nobility and Gentry of the Realm would take it into their ſerious and wiſe Conſideration, and begin firſt themſelves, by having all their Wheels ſo inverted, as to make what is now the Height of the Fellows, the Breadth thereof; by which Means the Wheels would be as broad again, without adding an Ounce to the Weight; for the Iron that is made Uſe of for the binding them now (by ſpreading it out as the Poets have done *Job*'s Butter) might be forged ſo as to anſwer the ſame End then. As to any Objection that may be made concerning their clumſy Look, I anſwer; that they would not look much more than half ſo prepoſterous, as they do now.

There is I know not what in Cuſtom, that fixes a Bias, on what I ſhall preſume to call the unthinking Part of Mankind, which makes them think that beſt, which they have been moſt uſed to. But I muſt beg Leave to ſay, that abating all Prejudice, a Wheel muſt look lighter on my Plan, than what are made on the preſent Principles.

For Example, let us ſuppoſe a Man never to have ſeen a Wheel in his Life, (but let us ſuppoſe him ſo wiſe as to know, that the Weight of like Bodies are proportion to their Bulk) and let two Wheels of the ſame Size, made on the two different Models be drove croſs the Road, *&c.* that he ſhall then be in; and that he ſhall be but a ſmall Diſtance from them, he muſt pronounce the Broad-Wheel to be but little more than half the Weight of the Narrow one. And for this obvious Reaſon; as Wheel-Carriages paſs us we ſee the Sides of the Wheels, and conclude them light or heavy, as they appear to us big or little.

If the feathered Race indeed were to determine this Point, they would give in Favour of the narrow-Wheels; becauſe they viewing them from above, would not ſee more than one half of the narrow Wheels Subſtance, and double the Quantity of what the Broad Wheels contained.

But broad Wheels, to thoſe who conſult Nicety, might be made to appear ſtill more light, by thinning the outward Edges, ſo as to bring the Wood-work down to within an Inch, more or leſs, as the Carriage required of the Iron-work, or bending; and ſuch Wheels as they paſſed us, what with their Rapidity, and ſmall Part ſeen by us, would appear extremely light; and as they would be thicker in the Middle, where the Spokes are morticed into the Fellows, and the Fellows being ſo much wider, could not be rubed away as they too often are now; and ſo let the Spokes out of their Mortices, before the Wheel in other Reſpects is half worn out; which could ſeldom happen, (or perhaps never) to the broad Wheel, eſpecially when we conſider, that were broad Wheels general, there would be no ſuch Thing as Ruts to rub againſt the Sides of them.

I hope the Nobility will excuſe my putting them laſt; for, as in drinking Tea, it is the greateſt Compliment to fill your Cup after all the reſt are ſerved; ſo I intend this as a Deference paid to them, by preſuming to make them the Baſis of this uſeful Work. If they will deign to lead the Way, and perſuade their Tenants, &c. into the Uſe of ſuch Wheels; as they know what Reaſons are beſt to be made Uſe of, and every Way qualified for ſuch a Taſk; I make no doubt, but what with their clear Reaſoning and perſuaſive Arguments, all that uſe Carriages would ſoon be brought into the Uſe of ſuch advantageous and uſeful Machines.

Notwithſtanding I ſaid juſt now, that I intended to make the Nobility the Baſis of this Work, I have conſidered ſince, in order that their Honours may be as conſpicuous as poſſible; that it will not be unneceſſary, but the rather uſeful, to throw ſome hard Rubbiſh into the Bottom of the Trench that is deſigned for the Foundation, in order that they may not be depreſſed too much below the Surface of the Earth; and having in my Lumber-Room lately found ſomething of that kind, I will even ſhovel it in without any farther Diſpute.

It is evident, that broad Wheels with the ſame Quantity of Iron-work round them, will laſt much longer than narrow ones.

The Reaſon is, that altho' the Binding, or Iron-work of the narrow Wheels is ſquare and level, if I may ſo call it, when it is firſt put on; it continues in that Form but a very little Time; the Wheel covering but ſo little

Part of the Earth's Surface, the Weight that it ſupporteth muſt force it into the Ground; and altho' it may ſeem as if the whole of what it preſſed on was drove before it to the Bottom of the Rut; yet, it is maniſeſt that that is not the Caſe. For the Part preſſed being ſo narrow, and the Earth, *&c.* reſiſting its downward Motion it endeavours to find, and great Part of it do make away up by the Sides of Wheels; and the Reſiſtance it meets with from below, makes it preſs, or grate very hard on the outward Edges and Sides of the Wheels as it riſes up. From hence it comes to paſs, that the Edge of the Wheel, inſtead of being ſquare and plain, ſoon becomes circular; and you may ſee little Furrows or Notches, which Gravel, Stones, *&c.* make from the middle of the Wheel to the outer Edges, croſs the Binding, which ſoon reduces the Edge of the Wheel to a circular Form; which makes it reſt on a ſtill leſs Quantity of the Surface it moves on; and ſo the Sides of the Wheel becomes more expoſed to the above Injuries; ſo that in a very little Time, the Fellows are ſo wore away on the Sides of them, that the Part of the Fellows between the outſide and the Spokes are ſo thin, that they find a Way through it, ſooner than the Owner deſires; all or moſt Part of which bad Conſequences may be prevented by the Uſe of broad Wheels.

As broad Wheels cover on their Motion a much greater Quantity of Ground than narrow ones, and of Conſequence cannot force their Way into the Earth above one fifth or ſixth Part of what the others do; there can be no ſuch Motion of the Earth under them, as there always is under the others. For the broad Wheels coming down as it were perpendicular, on ſo great a Quantity of Earth at once; the Parts ſo preſſed, endeavouring to recede (in any Direction) from the Preſſure they meet with, find their circumjacent Neighbours, for a great Way ſqueezed in the ſame Manner; ſo that they, have no Way to retire but downward; and the Earth for the moſt Part is ſo compact under the common Surface, that the greateſt Preſſure imaginable cannot force it much cloſer together than it naturally is. And I cannot but obſerve to you, that it is the Friction between the Wheel and the Earth, that wears away the Wheel; not its Motion, or Rotation on its Axis as a Wheel, on the Earth's Surface. And that this Grinding is vaſtly more in narrow, than broad Wheels, cannot be denied,

To prove that Grinding waſtes any thing more than Percuſſion, or forcing two Bodies together in a direct Line; ſuppoſe you take a

Hammer and go to a Block of Free-ſtone, the ſame Grindſtones are made of, (for you would ſplit a Grindſtone) ſit down on it, and lay on it with a Hammer, the moſt violent Blows you are capable of ſtriking; (but ſtrike Perpendicular as near as you can) keep on ſo for half an Hour; then obſerve how much of your Hammer is worn away, then go to the Grindſtone, and you will be able to grind away more of the Hammer in one Minute, than was waſted in half an Hour. From this Inſtance, as well as all others, I hope you will be convinced of the great Advantage of broad Wheels.

Another Objection againſt broad Wheels is, that when they are dragged, or tied up as in ſome Caſes is needful; they tear the Road to Pieces, by driving a great Quantity of Matter before them, and ſo do great Damage to the Roads; which as Things are at preſent circumſtanced, I acknowledge in ſome meaſure to be true: But I would have the Objector pleaſe to obſerve, that were broad Wheels only uſed, the Roads that are now plowed up and turn'd to Dirt in the Winter, and Duſt in the Summer, would then be ſo compact, as that which now ſometimes happens, would then ſeldom or ever come to paſs. What I obſerved in the above Caſe will hold good in this. So much of the Earth being covered at one Time, and being all equally preſſed, muſt remain at reſt as it were, ſo that the Wheel will eaſily ſlide over it.

But to make the Wheel ſlide on the Ground, without plowing ſo deep into it; permit me to propoſe the ſame Method that is made Uſe of in the Weſt of *England*, and of which the other Parts, (as far as I have ſeen at leaſt) ſeem to have no Notion.

The two hindmoſt Wheels of their Waggons, have each of them a Strake, or Piece of Iron, that is Part of the Binding, in the Middle of it twice or thrice as thick as the reſt, or than that is at the two Ends; ſo that there are three or four Nail-holes, at each End of the Strake, which is called the Drag-Strake, and the Part which is thick in the Middle is quite ſolid, and ſo hath not the Inconveniency of Nails, which make it ſo rough, and take ſuch hold of the Ground, and tear it up in ſo terrible a Manner.

When they are to drag a Wheel, they always take hold of that Spoke as exactly anſwers to bring the thick Place to the Bottom; and ſeldom or never, if it can be avoided, do they drag the Wheel with any other Part downwards; ſo that that Part ſoon becomes ſo glib, as to ſlide over the Ground without much Impreſſion: If it ſhould ſlide over too faſt, on account of the Hill's being very ſteep, they drag both hind Wheels, as both, as I have already ſaid, are provided with a drag-Strake. In order that the drag-Strake may be found in the darkeſt Night as may happen, they nail a Piece of Leather, *&c.* on that Spoke that the Chain muſt take hold of, in order to bring it exactly to the Bottom. And I cannot but obſerve further to you, that this Method greatly preſerves the Wheels; for on thoſe where there are no Places ſhod thicker than ordinary to drag them on, but are tied up whereſoever it may happen, have both the Wood and Iron Work much impaired by ſuch a Practice, which by the propoſed Method may be prevented.

So many are the Advantages that muſt neceſſarily ariſe from the Uſe of Broad Wheels, and ſo deſtructive to the Cattle and Purſe too is the going with narrow ones, that I ſhould not think my Time ill ſpent, if I were to write a large Volume in Folio, if by ſo doing I could croud into it Argument, Reaſon, and Demonſtration enough to perſuade my Fellow-Countrymen into the Uſe of them. But if all I have done, or may do, ſhould prove abortive, I hope I ſhall meet with ſo much Candor from my Countrymen in general, as not to be thought one who would ſow Diſcord in the World; but pleaſe to think of me as one who would think no Trouble, Pains, Danger, Time or Coſt badly beſtowed, could he but ſerve his Country. Think but this of me, I ſay (as I ſolemnly declare you do not do me Juſtice if you don't) and ſuppoſe I meant well to my Country, tho' ſo ignorant as not to know how to be uſeful in my Generation: This, this, I hope, common Humanity, as I am a Man and a Chriſtian, will be beſtowed upon me: And if I meet with but that, I ſhall have the Comfort to think, that I have not brought on myſelf the Diſeſteem of any one by my fruitleſs Endeavours to ſerve every Body.

If broad Wheels ſhould become general, I make no doubt but that many Improvements will be made on them, as well as there has been on all uſeful Diſcoveries that have hitherto been made. I think that the Tire of broad Wheels may be made all in one Piece, broad enough to cover the whole Width of the Fellows; or two at moſt would be ſufficient. There are ſome Objections may ariſe againſt both; that which is all in one Piece, by having a Joint quite croſs the Wheel, it may chance to be where there is an imperceptible Weakneſs in the Fellow; and ſo the Wheel, by ſome ſudden Jerk or Twiſt, may break at that Place, which by having two Strakes, putting one End of one to the middle of the other,

might

might have been prevented. But altho' I ſeem to think this a material Conſideration, it don't appear that they who have made the few broad Wheels that are uſed, thought it ſo mighty a Matter, for they all have three Strakes round them. I have ſeen ſome where they have been even at the Ends, and ſo made one ſtreight Joint, croſs the Wheel. Now if one may conclude from this, that a Joint croſs the Wheel doth not ſignify; I then aver, that one broad Sheet of Iron is better than two, becauſe being all in one Piece, it muſt keep the Fellows from ſplitting, by having the Wheel go (tho' it is what could ſeldom happen, on account of the Roads being rolled with the broad Wheels, in ſo much, that I aver, that there are an hundred looſe Stones, and Prominences on our Roads now, where there would be but one then) over a Stone quite out of the Ground, or Part in and Part out, and ſo throwing the whole Weight on that Edge of the Wheel as may happen to go over it; for being in one Piece, tho' the Stone or Knob ſhould happen to be near the Outſide, yet by its being all in one Sheet of Iron, the Weight would preſs nearly equal on the whole Surface of the Wheel; and of Courſe not ſo liable to be broke as with two or three Tire, where the Force that may happen to one, is noways aſſiſted by the other. It may be objected that ſuch a Tire could not be forged by our Smiths without a vaſt Expence and Trouble. To which I anſwer, That if by Experience it were found, that our common Forges were not equal to the Taſk, how eaſy would it be to have them forg'd at our great Iron Forges where any Thing may be form'd, ſo as to anſwer the End deſigned; and ſo leave our Wheelwrights or Smiths no more to do than juſt to heat them, and put them on. If they were made about a Quarter of an Inch thick, or but little more, for the Reaſons I have already given, they would laſt longer than a Binding on our preſent narrow Wheels would do, that had double the Quantity of Iron in the ſame Breadth. Our Iron Forges now make moſt of our large Implements, only leaving them to be fitted and formed for their reſpective Uſes.

I find that if I do not reſolve with myſelf to put a final Period to this Work, I ſhall not know where to end. So much may be ſaid on the Behalf of broad Wheels, that it were endleſs to enumerate all the Advantages that will ariſe from the general Uſe of them. I ſhall therefore conclude with an earneſt Exhortation to all that uſe Carriages, to conſider ſeriouſly whether what I have ſaid, or what they may hear ſay in future, by more enlarged Underſtandings, has any Truth or Reaſon on its Side. And if they can but diveſt themſelves of that Prejudice which we all have, more or leſs, before they begin to make the Scrutiny; I flatter myſelf that what I have been ſaying, and endeavouring to prove, is ſo obvious, that every impartial Mind will acquieſce in the Truth of it; which if I do but live to hear, and ſee the happy Effects of, I ſhall think I have done enough, ſuppoſing that the World, through my Perſuaſion, is perſuaded into the Uſe of broad High Wheels; and ſhall not be deſirous of living any longer, unleſs I could ſtill employ my Time ſo as to be of farther Service to my Country, and be clapt off the Stage, as by leaving it now, I ſhould certainly be. But whether I am clapt or hiſs'd off the Theatre of the World, it will give me little or no Concern, if I go off with a Conſciouſneſs that I have made it my Buſineſs to anſwer the End for which I was called into Being; namely, to do the greateſt Glory to God, the moſt Good to my Country, and ſecure to myſelf a Part to act on that glorious Stage of which God himſelf is the Maſter; and of which bliſsful Play there is no End.

FINIS.